

REQUEST AND RECOMMENDATION

ONE YEAR OPTION

900+ Clock Hour Programs – Heating, Ventilation, and Air Conditioning (HVAC)

Background:

To provide another option for adult students to apply prior learning toward a degree, Ohio legislators established what has come to be known as the One-Year-Option through Section 363.120 House Bill 59 of the 130th General Assembly. The Chancellor of the Ohio Department of Higher Education, in consultation with the Superintendent of Public Instruction and the Governor's Office of Workforce Transformation, was tasked to establish a One-Year Option credit articulation system in which graduates of Ohio's adult career-technical institutions who complete a 900-hour program of study AND obtain an industry-recognized credential approved by the Chancellor will be able to receive 30 technical semester credit hours toward a technical degree upon enrollment in a public institution of higher education. The Chancellor was also to recommend a process to award proportional semester credit hours for adult career-technical institution students who complete a program of study between 600 and 899 hours AND obtain an industry-recognized credential approved by the Chancellor. The Chancellor convened a broad group of stakeholders to develop a system of articulation for the One Year Option that was presented in a report to the legislature called, *"Getting to 30: Establishing a One Year Option Credit Articulation System for Ohio."*

In order to implement the system of articulation developed with the stakeholders as well as address accreditation requirements for degree granting institutions, the Chancellor convened Credit Affirmation Teams (CATs) to conduct a peer review of programs and certifications for affirmation for a block of 30 semester hours of technical credit. The CATs were comprised of faculty and administrators from Ohio Technical Centers (OTCs) and an equal number from public degree granting colleges and universities in Ohio. The CATs were organized by four discipline clusters: Health and Allied Health, Building and Industrial Technology, Business and Information Technology, and Services. They were charged with reviewing the certifications and, if necessary, program content, to affirm that students completing the selected program at an Ohio Technical Center and earned approved certifications had demonstrated competencies equivalent to 30 semester hours of technical credit. This technical credit would then be granted, as a block, upon enrollment in a degree granting institution. Additional subject matter experts were consulted when core team members did not have sufficient content knowledge of the program being reviewed.

Recommendation

As detailed in the attached template, the Building and Industrial Technology Credit Affirmation Team recommends that students will be eligible for a block of 30 semester hours of technical credit towards an *Associate of Technical Studies in Building and Industrial Technology* when:

- the student has successfully completed a 900+ clock hour program in Heating, Ventilation, and Air Conditioning (HVAC) at an Ohio Technical Center.

And currently meets requirements for one of the following pathways:

Pathway 1:

- NCCER Core
- NCCER HVAC Level 1
- NCCER HVAC Level 2
- NCCER HVAC Level 3
- EPA 608 Universal Certificate
- OSHA 10- General Industry

Pathway 2:

- HVAC Excellence: Employment Ready: Core Competencies
- HVAC Excellence: Employment Ready: Electrical
- HVAC Excellence: Employment Ready: Air Conditioning
- HVAC Excellence: Employment Ready: Electrical Heat
- HVAC Excellence: Employment Ready: Heat Pump
- HVAC Excellence: Employment Ready: Gas Heat
- HVAC Excellence: Employment Ready: Oil Heat
- EPA 608 Universal Certificate
- OSHA 10 General Industry

Pathway 3:

- NATE Core
- NATE Specialty Exam: Air Conditioning
- NATE Specialty Exam: Air Distribution
- NATE Specialty Exam: Air-to-Air Heat Pump
- NATE Specialty Exam: Gas Furnace
- NATE Specialty Exam: Oil Furnace
- EPA 608 Universal Certificate
- OSHA 10- General Industry

Please note these certifications must be current and valid. Student must have been completed the Ohio Technical Center program within 5 years.

End of Comment Period: May 18, 2017 at 8:00 AM
No comments received, recommend approval

RECOMMENDATION

The Vice Chancellor of Academic Affairs has verified that this pathway has met the standards and requirements of the Ohio Board of Regents.

SDavidson

5/22/17

Stephanie Davidson, Vice Chancellor of Academic Affairs

Date

APPROVAL

J. Carey

John Carey, Chancellor

6/8/17

Date

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900 Clock Hour Certification Affirmation

Preamble

After a comprehensive review, the team agreed that due to the differing industry needs of employers located within Ohio Technical Center's geographic area, there are three separate pathways a student could complete. By completing one of the following pathways and a 900 or more clock hour program at an Ohio Technical Center, a student will qualify to earn 30 technical credits at a public degree-granting college or university in Ohio.

Pathway 1:

- NCCER Core
- NCCER HVAC Level 1
- NCCER HVAC Level 2
- NCCER HVAC Level 3
- EPA 608 Universal Certificate
- OSHA 10- General Industry

Pathway 2:

- HVAC Excellence: Employment Ready: Core Competencies
- HVAC Excellence: Employment Ready: Electrical
- HVAC Excellence: Employment Ready: Air Conditioning
- HVAC Excellence: Employment Ready: Electrical Heat
- HVAC Excellence: Employment Ready: Heat Pump
- HVAC Excellence: Employment Ready: Gas Heat
- HVAC Excellence: Employment Ready: Oil Heat
- EPA 608 Universal Certificate
- OSHA 10 General Industry

Pathway 3:

- NATE Core
- NATE Specialty Exam: Air Conditioning
- NATE Specialty Exam: Air Distribution
- NATE Specialty Exam: Air-to-Air Heat Pump
- NATE Specialty Exam: Gas Furnace
- NATE Specialty Exam: Oil Furnace
- EPA 608 Universal Certificate
- OSHA 10- General Industry

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The Program Affirmation is designed to provide a common matrix for a peer review process acceptable to the Higher Learning Commission to soundly affirm award 30 semester hours of technical credit for Ohio Technical Center graduates who are eligible for the One Year Option. The template should be completed for every program/subject and signed by the co-chairs of each of the four-cluster program areas for every Industry-recognized credential and program reviewed.

Please note: All Ohio Technical Centers must be accredited by one of the following: [Council on Occupational Education \(COE\)](#) and/or [Accrediting Commission of Career Schools and Colleges \(ACCSC\)](#).

Program Name: Heating, Ventilation, Air Conditioning and Refrigeration Engineering Technology/Technician	Cluster <input type="checkbox"/> Business & Information Technologies <input type="checkbox"/> Health/Allied Health <input checked="" type="checkbox"/> Industrial Trades <input type="checkbox"/> Service Industries & Agriculture
CIP Code: 47.0201	
CIP CODE PROGRAM DEFINITION	
A program that prepares individuals to apply technical knowledge and skills to repair, install, service and maintain the operating condition of heating, air conditioning, and refrigeration systems. Includes instruction in diagnostic techniques, the use of testing equipment and the principles of mechanics, electricity, and electronics as they relate to the repair of heating, air conditioning and refrigeration systems.	
STEP ONE: CREDENTIAL REVIEW: PATHWAY I	
	Details/Explanation
Primary Industry Credential (if there are competing certifications complete page multiple times)	Name: The National Center for Construction Education and Research (NCCER) Certifications Type: <input type="checkbox"/> License <input type="checkbox"/> Registry <input checked="" type="checkbox"/> Certification
Program requirements by credentialing body.	The program must be a NCCER Accredited Training Sponsor (ATS) and a NCCER Accredited Assessment Center. "Entities that have been approved by NCCER as having the resources to effectively conduct a quality training program that utilizes NCCER curriculum are designated as an ATS. Entities that have been approved by NCCER as having the resources to effectively
	Comments
	<ul style="list-style-type: none"> NCCER Core NCCER HVAC Level 1 NCCER HVAC Level 2 NCCER HVAC Level 3
	About the Exams: NCCER offers a complete series of entry- and journey-level written assessments as part of its National Craft Assessment and Certification Program (NCACP). These assessments evaluate the knowledge of an individual in a specific craft area

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	<p>conduct a quality assessment program that utilizes the National Craft Assessment and Certification Program (NCACP) assessments and performance verifications are designated as an NCCER Accredited Assessment Center. NCCER's accreditation process assures that students and craft professionals receive quality training based on uniform standards and criteria. Training Sponsors and Assessment Centers are subject to audit on a three year cycle."</p> <p>For more information, please see: http://www.nccer.org/assessments-performance-verifications?mID=616</p>	<p>and provide a prescription for upgrade training when needed. All assessments are based upon the NCCER Curriculum and have been developed in conjunction with Subject Matter Experts from the industry and Prov™, NCCER's test development partner. Module assessments consist of knowledge verification via the successful completion of a written assessment. In addition to the knowledge verification, some modules also require successful completion of a practical performance in the laboratory setting.</p> <p>Renewal: NCCER does not have a renewal option.</p> <p>Exam Integrity: NCCER, through their testing partner Prov, administers training module exams through a secure web-based platform, the Testing Management System. Module tests are created, launched, scored and electronically stored. Instructors and proctors are certified to NCCER requirements.</p>
Instructional hours	<p>NCCER Core required instructional hours: 72.5 NCCER HVAC 1 required instructional hours: 102.5 NCCER HVAC 2 required instruction hours: 175 NCCER HVAC 3 required instructional hours: 142.5 All competencies must be covered. Remaining 407.50 hours may vary per program based on local advisory business/industry committees</p>	<p>492.5 clock hours of instruction to complete NCCER Curriculum requirements.</p>
Competencies demonstrated by credential attainment.	<p>NCCER Core Competencies:</p> <ul style="list-style-type: none"> • Module 00101-09: Basic Safety • Module 00102-09: Introduction to Construction Math • Module 00103-09: Introduction to Hand Tools • Module 00104-09: Introduction to Power Tools • Module 00105-09: Introduction to Construction Drawings • Module 00106-09: Basic Rigging (Elective) 	<p>Each equipment specific module typically contains operation, controls, maintenance, and safety guidelines.</p> <p>NCCER Core http://www.nccer.org/uploads/fileLibrary/Core_2009_courseplanning816201351231PM63.pdf</p>

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- Module 00107-09: Basic Communication Skills
- Module 00108-09: Basic Employability Skills
- Module 00109-09: Introduction to Materials Handling

NCCER HVAC Level 1 Competencies:

- Module 03101-07: Intro to HVAC
- Module 03102-07: Trade Mathematics
- Module 03103-07: Copper and Plastic Piping Practices
- Module 03104-07: Soldering and Brazing
- Module 03105-07: Ferrous Metal Piping Practices
- Module 03106-07: Basic Electricity
- Module 03107-07: Intro to Cooling
- Module 03108-07: Intro to Heating
- Module 03109-07: Air Distribution

NCCER HVAC Level 2 Competencies

- Module 03201-07: Commercial Airside Systems
- Module 03202-07: Chimneys, Vents, Flues
- Module 03203-07: Introduction to Hydronic Systems
- Module 03204-07: Air Quality Equipment
- Module 03205-07: Leak Detection, Evacuation, Recovery and Charging
- Module 03206-07: Alternating Current
- Module 03207-07: Basic Electronics
- Module 03208-07: Intro to Control Circuit Troubleshooting
- Module 03209-07: Troubleshooting Gas Heating
- Module 03210-07: Troubleshooting Cooling
- Module 03211-07: Heat Pumps
- Module 03212-07: Basic Installation and Maintenance Practices
- Module 03213-07: Sheet Metal Duct Systems
- Module 03214-07: Fiberglass and Flexible Duct Systems

NCCER HVAC Level 3 Competencies

- Module 03301-08: Refrigerants and Oils

NCCER HVAC Level 1

http://www.nccer.org/uploads/fileLibrary/HVAC_L1_2013_CEPs.pdf

NCCER HVAC Level 2

http://www.nccer.org/uploads/fileLibrary/HVAC_L2_CEPs_4th%20Ed.pdf

NCCER HVAC Level 3

http://www.nccer.org/uploads/fileLibrary/HVAC_L3_CEPs_4th%20Ed.pdf

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- Module 03302-08: Compressors
- Module 03303-08: Metering Devices
- Module 03304-08: Retail Refrigeration Systems
- Module 03305-08: Commercial Hydronic Systems
- Module 03306-08: Steam Systems
- Module 03307-08: Planned Maintenance
- Module 03308-08: Water Treatment
- Module 03309-09: Troubleshooting Electronic Controls
- Module 03310-08: Troubleshooting Heat Pumps
- Module 03311-08: Troubleshooting Accessories

Rationale:

The Trades and Industry Credit Affirmation Team (CAT) utilized the following process to complete the assessment regarding the number of semester hours that would be awarded at the college level as block credit based on the industry credentials plus 900-clock hours earned at an Ohio Technical Center (OTC).

- Research the competencies tested by the industry credential(s). The Trades and Industry CAT reviewed information about the industry credential(s) to determine the competencies signaled by earning the credential(s).
- Complete a nationwide internet search to review how other accredited colleges and universities are applying credit to NCCER Core, HVAC 1, HVAC 2, and HVAC 3. Pima Community College awards 24.75 college credits towards an Associate of Applied Science degree in Business and Industry Technology to students of NCCER's accredited sponsors who successfully complete NCCER Core, HVAC 1, HVAC 2, and HVAC 3 standardized craft training modules and the Pima-approved challenge exam for those modules. In addition, the Kansas Board of Regents has articulated the NCCER Core, HVAC 1, and HVAC 2 certifications for up to 44 credit hours. Also, NCCER HVAC 1, HVAC2, and HVAC 3 are recognized by NATE (North American Technician Excellence).
- Review the value of local program advisory committee recommendations to meet the local industry needs. The Team concurred that there was value in having lab/practical, internships and/or externships as part of the program to meet local industry/business needs.
- Review OSHA 10-Hour Hazard Recognition Training for General Industry. OSHA 10 includes content essential to general-related work such as fall protection, personal protective equipment, fire prevention and safety, OSHA inspection procedures and more.
- Review EPA 608 Universal Licensure Training. EPA 608 Universal Licensure includes content essential to Clean Air Act, Montreal Protocol, Section 608 Regulations regarding refrigeration, recovery, leak detection and repair, recharging and safety.

The Trades and Industry CAT confirms:

- The certifications exams are valid, reliable and peer-reviewed on a regular basis to ensure the content accurately

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measures intended competencies.

- The competencies measured by the NCCER Core, HVAC 1, HVAC 2, HVAC3, OSHA 10 and EPA 608 Universal certificate are developed by industry and reflect industry standards.

The Trades and Industry CAT also considered competencies signaled by lab and practical learning experiences. As part of the program offered by OTCs, student will participate in lab/practical experience as recommended by the local program advisory committee to meet local business and industry needs. The lab/practical experiences will reinforce the instructional competencies through hands-on learning.

Upon successful completion of the 900+ hour program in the field of plumbing at an Ohio Technical Center and attainment of the following certifications:

- NCCER Core
- NCCER HVAC Level 1
- NCCER HVAC Level 2
- NCCER HVAC Level 3
- OSHA 10- General Industry
- EPA 608 Universal Certificate

A student shall be awarded 30 technical semester hours toward completion of an Association of Technical Studies at a public degree granting college or university.

-OR-

Program Name: Heating, Ventilation, Air Conditioning and Refrigeration Engineering Technology/ Technician CIP Code: 47.0201	Cluster <input type="checkbox"/> Business & Information Technologies <input checked="" type="checkbox"/> Health/Allied Health <input checked="" type="checkbox"/> Industrial Trades <input checked="" type="checkbox"/> Service Industries & Agriculture						
STEP ONE: CREDENTIAL REVIEW: PATHWAY 2							
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 60%; text-align: center;">Details/Explanation</th> <th style="width: 40%; text-align: center;">Comments</th> </tr> </thead> <tbody> <tr> <td> Primary Industry Credential (if there are </td> <td> Name: HVAC Excellence: Employment Ready Certifications Type: </td> </tr> <tr> <td></td> <td> HVAC Excellence: Employment Ready Certifications </td> </tr> </tbody> </table>	Details/Explanation	Comments	Primary Industry Credential (if there are	Name: HVAC Excellence: Employment Ready Certifications Type:		HVAC Excellence: Employment Ready Certifications
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competing certifications complete page multiple times)	<input type="checkbox"/> License <input type="checkbox"/> Registry <input checked="" type="checkbox"/> Certification	<ul style="list-style-type: none"> • Core Competencies • Electrical • Air Conditioning • Heat Pump • Electric Heat • Gas Heat • Oil Heat
Program requirements by credentialing body.	<p>All standards (Codes, specification, recommend practices, methods, classifications and guides) of the ESCO HVAC Excellence have developed to meet Federal, State and institutional requirements. Each HVAC Excellence: Employment Ready Certification is a “stand alone” certificate. These discipline specific exams helps to evaluate student achievement creating documentation of a person's retained knowledge necessary for employment in the HVACR industry.</p>	<p>About the Exams: Developed as end-of course exams. Examinations are developed through the input of technical experts, also referred to as "Subject Matter Experts" or SME's. To develop any national test, a minimum of five and a maximum of nine technical experts from three states are essential.</p> <p>Renewal: None</p> <p>Exam Integrity: Content is developed by a “job and task analysis” process within the field of occupation. The SME's develop a table of test specifications which establishes the construct validity and the semantic validity of the assessment. Through the item analysis process, each test question is validated for “reliability.”</p> <p>HVAC Excellence: Employment Ready Certifications http://www.hvacexcellence.org/EmploymentReady.aspx</p> <p>HVAC Excellence Accreditation Manual http://www.hvacexcellence.org/Documents/AccreditationManual/index.html#26/z</p>
Hour Requirements	Locally developed curriculum to meet the needs of local industry	

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(includes any instructional, lab/practice hours, or internship hours).	needs.	
Competencies demonstrated by credential attainment.	<p>The following end-of-course examinations are required to verify the students' knowledge in a 900 clock hour OTC program.</p> <p>HVAC Excellence: Employment Ready Competencies</p> <p>Core Competencies</p> <ul style="list-style-type: none"> • Converting fractions to decimals and decimals to fractions • Calculating squares, cubes, and roots • Solving equations • Calculating ΔT • Converting English measurements to metric measurements • Ratios and proportions as they relate to various equipment and components such as: compressors and pumps, pulleys, drive systems, fans • Calculate duct sizing using duct sizing formulas • Calculate a residential structure heat loss and gain • Differentiate between Renewable and Sustainable energy • Define the following acronyms: BIM, CBECS, ECM, EIA • Describe an energy audit • Describe a Life Cycle cost Analysis • Define: EER, SEER, AFUE, HSPF, COP, ECM • Define psychometrics fundamentals • Explain the thermodynamics of air and water vapor • Explain the water vapor cycle in the Earth's atmosphere • Define standard air volume and density • Identify each line on the psychometric chart and explain the properties • Plot any two basic points on and psychometric chart and evaluate the data • Explain the comfort zone and the different temperatures 	<p>Minimum Tasks and Competencies for HVAC Excellence Accredited Programs http://www.hvacexcellence.org/EmploymentReady.aspx</p> <p>Exam Development http://www.hvacexcellence.org/ExamDevelopment.aspx</p>

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and relative humidity's effect on human comfort.

- Describe the eight process of air conditioning and how to plot each on a psychometric chart
- Define and use the Process Triangle on the psychometric chart to calculate, sensible heat, latent heat and total heat.
- Explain sensible heat ratios
- Calculate mixed air problems for infiltration and ventilation
- Develop critical thinking skills including analysis, evaluation, calculations and the use of the computer technology.

Electrical

- Define the structure of an atom
- Describe the difference between positive and negative charged atoms
- Describe potential difference
- Describe current flow
- Describe Ohm's Law and solve problems applying Ohm's Law
- Describe and demonstrate the effects of voltage drop in a series circuit
- Calculate and measure the voltage output of a transformer using the number of turns on the primary vs. the secondary sides
- Define impedance
- Define and identify conductors
- Describe and identify insulators
- Define and identify semi-conductors
- Identify the types and describe the proper application and use of "Circuit Protectors"
- Identify, describe, and explain the function and application of: Contactors , Loads, switches, Line starters, Solenoid valves, Defrost timers, Transformers, Thermostats, Positive temperature coefficient thermistors, Heat

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anticipators, Negative temperature coefficient thermistor
Relays

- Describe how capacitors are rated and tested
- Describe how overload protectors function
- Evaluate, replace and describe the function, application and wiring of a start capacitor
- Evaluate, replace and describe the function, application and wiring of a run capacitor
- Describe and explain motor speed
- Explain and change the direction of rotation in a single phase motor
- Describe a three phase motor
- Explain the difference between a Wye and Delta three phase motor
- Describe a dual voltage three phase motor
- Describe a permanent split capacitor motor, capacitor start induction run motor, and a multi speed motor
- Describe the operation and characteristics of an Electronically Commutated Motor (ECM)
- Describe the difference between a “Pictorial”, a “Ladder Diagram”, and a “Schematic”
- Identify electrical symbols used in HVACR schematics
- Identify inoperative/defective component using schematic wiring diagrams
- Identify voltage between two points using schematic wiring diagrams
- Determine sequence of operation using schematic wiring diagrams

Air Conditioning:

- Define enthalpy and entropy
- Explain condensation of a vapor, and its effect on heat
- Explain vaporization of a liquid, and its effect on heat
- Describe change of state
- Define vacuum as it is used in the HVACR industry

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- Describe the following oils and their applications; Mineral, Alkylbenzene, Glycols, and Esters
- Describe the thermodynamics of refrigerants
- Identify and define the following types of blends; Binary, Ternary, Azeotropic, and Near Azeotropic
- Identify and define; CFC's, HCFC's, and HFC's
- Describe fractionation and its causes
- Describe temperature glide
- Define and demonstrate refrigerant recovery
- Define and demonstrate refrigerant recycling
- Define reclaim
- Describe the six types of leak detectors
- Explain the method for pinpointing a leak.
- Explain the proper use of each type of leak detector and their applicability.
- Explain the proper use and handling of nitrogen in the leak detection process
- Describe the principles of dehumidification and humidification.
- Describe and define the following; BTU, latent heat, sensible heat,
- Describe and define the following; subcooled liquid, superheated vapor.
- Describe and define the following; wet bulb temperature, dry bulb temperature, and dew point.

Electric Heat

- Define BTU
- Differentiate between a resistive and inductive load
- Define Coefficient of performance
- Define Watts Law
- Identify the formula for sensible heat
- Describe maximum allowable voltage imbalance in a three phase circuit

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- Measure the voltage imbalance in a three phase circuit
- Identify the heating value of one Watt in BTU's
- Describe and demonstrate the method of measuring static pressure
- Describe the effects of relative humidity on comfort and health
- Describe voltage tolerances
- Describe sensible and latent heat
- Describe the principles of dehumidification and humidification
- Describe and a dual transformer system
- Identify the material used to construct electric heater elements
- Describe the insulating properties of mica and ceramics and their application
- Describe the operation of, and evaluate/replace a limit switch
- Describe snap discs and their operation
- Describe the operation and purpose of, and evaluate/replace a fan interlock switch
- Describe how electric heating elements are rated
- Describe how a sequencer controls blower operation
- Describe the types and proper sizing of drive belts
- State the typical operating characteristics of a direct drive blower
- Identify the various types of motor mounts used on residential furnace blower assemblies
- Describe procedures for retrofit of a system to electric heat
- State the minimum required clearances for service and safety of an electric furnace
- Determine appropriate wire size for electric furnace installation
- Describe and demonstrate the proper soldering procedures for electrical wiring

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- Describe and calculate wire sizing as it applies to voltage drop and length of wiring run
- Identify the proper location for and install a conventional thermostat
- Explain the detailed wiring and operation of a setback programmable thermostat
- Explain the procedure for setting a heat anticipator on an electric furnace
- Identify the NEC code requirements for residential thermostat wiring
- Explain the procedure for determining CFM
- State the recommended air velocities throughout the supply and return duct system
- Describe the construction and efficiencies of varying filtering media and systems
- Describe “R” values and application of various duct insulation materials
- Describe the effects of static pressure on air flow

Heat Pump

- Describe the principles of dehumidification and humidification
- Describe the six types of leak detectors
- Describe the method of pinpointing a refrigerant leak
- Explain the use and handling of nitrogen in the leak detection process
- Explain the operation and use of a gauge manifold assembly
- Determine proper charging of HCFC and HFC refrigerants into an operating system
- Determine proper charging of HCFC and HFC refrigerants into an empty system
- Select the proper refrigerant oil for an operating system
- Explain charging using the manufacturers literature
- Determine required superheat and subcooling for an

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operating system

- Calculate the amount of refrigerant required for a system to weigh-in a charge
- Explain charging using the superheat method
- Explain charging using the subcooling method
- Describe the triple evacuation method
- Identify the types of micron gauges
- Explain the method for connecting a micron gauge to the system
- Describe the function of a lockout relay in a circuit
- Describe the function of and the testing method for a run and start capacitor
- Describe and install a compressor potential start relay
- Describe the operation of and the testing method for a high pressure switch
- Describe the operation of and the testing method for a low pressure switch
- Identify and differentiate between the various types of service valves
- Explain the function of a liquid line drier
- Explain the function of a liquid line bi-flow drier
- Explain the function of a suction line filter drier
- Describe the procedure to perform a compressor efficiency test
- Describe the operation of a heat/cool relay
- Describe the operation of the following defrost controls, mechanical, time/temperature, and solid state
- State the purpose of and testing method for a bimetal outdoor coil temperature sensor
- Describe a thermistor type temperature sensor (PTC & NTC).
- Describe a heat pump's design, configuration for both the heating and cooling cycle
- Describe the sequence of the defrost cycle

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- Describe the operation of and the testing method for a defrost relay
- Describe the function of and testing method for an outdoor thermostat
- Describe the function and the control methods used by an indoor electronic thermostat
- Explain how the set points for outdoor thermostats are established
- Describe the operation of a reversing valve.
- Describe the procedures for testing the operation of a reversing valve
- State the purpose of an accumulator and how it is constructed
- Describe the principle of operation of a capillary tube
- Describe the principle of operation of a fixed orifice
- Describe the principle of operation of a thermostatic expansion valve
- Describe the principle of operation of an electronic expansion valve.
- Describe the function of and the testing method for a control circuit fuse
- Describe a heat pump thermostat with emergency heat feature
- Describe a defrost board and its operation
- Define SEER, HSPF, and COP
- Describe heat pump charging procedures
- Describe crankcase heating methods and how they operate
- Describe a check valve, its function and operation
- Differentiate between a compressor designed for use in a heat pump and one that is designed for use in a cooling only air conditioner

Gas Heat

- Define BTU
- Define AFUE

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- Define and differentiate between primary air and excess air.
- Describe and state the causes of burner “Flashback”
- Describe and state the causes of a lifting flame.
- State the maximum percentage of Carbon Dioxide produced by the perfect combustion of natural gas
- State the maximum percentage of Carbon Dioxide produced by the perfect combustion of propane gas
- State the reason for appropriate polarity wiring on solid state circuits
- State the generally accepted standard gas manifold pressure for a residential furnace
- State the formula for sensible heat.

Oil Heat

- Define BTU
- Define AFUE
- State the quantity of combustion air required to burn one gallon of fuel oil
- Define and differentiate between primary air and excess air
- State the cubic feet of flue gas produced for every gallon of fuel burned.
- State the maximum percentage of Carbon Dioxide produced by the perfect combustion #2 fuel oil
- State the reason for appropriate polarity wiring on solid state circuits
- State the formula for sensible heat.

Rationale:

The Trades and Industry Credit Affirmation Team (CAT) utilized the following process to complete the assessment regarding the number of semester hours that would be awarded at the college level as block credit based on industry credential(s) plus 900-clock hours earned at an Ohio Technical Center (OTC).

- Research the competencies tested by the industry credential(s). The Trades and Industry CAT reviewed information about the industry credential(s) to determine the competencies signaled by earning the credential(s).
- Complete a nationwide internet search to review how other accredited colleges and universities are applying credit to HVAC Excellence: Employment Ready Certifications. Hillyard Technical College has an articulation agreement

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with North Central Missouri College for 30 semester hours towards an Associate of Applied Science in Applied Technology (1 + 1 Program) who successfully complete HVAC Excellence Exams. In addition, there is an articulation agreement between the HVAC Excellence Exams and the Local Union of United Association of Journeymen and Apprenticeship of the Plumbing and Pipe Fitters Industry for credit towards the first year of the apprenticeship program for individuals who successfully complete the HVAC Excellence Exams. In addition, the Kansas Board of Regents has articulated the HVAC Excellence Exams test up to 44 credit hours.

- Review the value of local program advisory committee recommendations to meet the local industry needs. The Team concurred that there was value in having lab/practical, internships and/or externships as part of the program to meet local industry/business needs.
- Review OSHA 10-Hour Hazard Recognition Training for the General Industry. OSHA 10 includes content essential to general-related work such as fall protection, personal protective equipment, fire prevention and safety, OSHA inspection procedures and more.
- Review EPA 608 Universal Licensure Training. EPA 608 Universal Licensure includes content essential to Clean Air Act, Montreal Protocol, Section 608 Regulations regarding refrigeration, recovery, leak detection and repair, recharging and safety.

The Trades and Industry CAT confirms:

- The certifications exams are valid, reliable and peer-reviewed on a regular basis to ensure the content accurately measures intended competencies.
- The competencies measured by the HVAC Excellence: Employment Ready Certifications in the areas of Core Competencies, Electrical, Air Conditioning, Electric Heat, Heat Pump, Gas Heat, Oil Heat, EPA 608 Universal and OSHA 10 General Industry are developed by industry and reflect industry standards.

The Trades and Industry CAT also considered competencies signaled by lab and practical learning experiences. As part of the program offered by OTCs, student will participate in lab/practical experience as recommended by the local program advisory committee to meet local business and industry needs. The lab/practical experiences will reinforce the instructional competencies through hands-on learning.

Upon successful completion of the 900+ hour program and attainment of the following certifications:

- HVAC Excellence: Employment Ready: Core Competencies
- HVAC Excellence: Employment Ready: Electrical
- HVAC Excellence: Employment Ready: Air Conditioning
- HVAC Excellence: Employment Ready: Electrical Heat
- HVAC Excellence: Employment Ready: Heat Pump

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- HVAC Excellence: Employment Ready: Gas Heat
- HVAC Excellence: Employment Ready: Oil Heat
- EPA 608 Universal
- OSHA 10 General Industry

A student shall be awarded 30 technical semester hours toward completion of an Association of Technical Studies at a public degree granting college or university.

-OR-

Program Name:
 Heating, Ventilation, Air
 Conditioning and
 Refrigeration
 Engineering Technology/
 Technician

Cluster

- ☐ Business & Information Technologies
- ☐ Health/Allied Health
- ☒ Industrial Trades
- ☐ Service Industries & Agriculture

CIP Code: 47.0201

STEP ONE: CREDENTIAL REVIEW: PATHWAY 3

	Details/Explanation	Comments
Primary Industry Credential (if there are competing certifications complete page multiple times)	Name: NATE ICE (KATE's) Certification for Installers Type: <input type="checkbox"/> License <input type="checkbox"/> Registry <input checked="" type="checkbox"/> Certification	<ul style="list-style-type: none"> • NATE Core • NATE Specialty Exam: Air Conditioning • NATE Specialty Exam: Air Distribution • NATE Specialty Exam: Air-to-Air Heat Pump • NATE Specialty Exam: Gas Furnace • NATE Specialty Exam: Oil Furnace
Program requirements by credentialing body.	NATE exams are based on Knowledge Areas Of Technician Expertise (KATEs). The KATEs divide the certification process into tests for installation, service and senior-level technicians. The tests recognize different levels of experience and knowledge. NATE KATEs are statistically proven job task analysis from experts in the HVACR industry. KATEs represent a wide variety	About the Exams: The NATE Technical Committee oversees the Knowledge Areas of Technician Expertise (KATEs) and all test development. The KATEs are the statistically proven job task analysis from which all questions are developed. All exams are developed by

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	<p>of perspectives on subject matter pertinent to contractors, technicians, distributors, educators, manufacturers and utilities. There are no educational or work experience requirements, yet NATE strongly recommends individuals have some formal training provided by an employer, a technical school or other educational institution before taking relevant NATE exams.</p> <p>NATE suggest:</p> <ul style="list-style-type: none"> • One year of experience or vocational training for installation technician tests • Two years of experience for service technician tests • Five years of experience for senior level technician 	<p>subject matter experts from across the HVAC/R industry representing a wide variety of perspectives which includes contractors, technicians, distributors, educators, manufacturers, and utilities.</p> <p>Renewal: Prior to January 2014, individuals must recertify every 5 years plus provide evidence of 60 continuing education hours. After January 2014, individuals must recertify every 2 years plus provide evidence of 16 continuing education hours.</p> <p>Exam Integrity: The NATE Technical Committee, comprised of industry experts nationwide, oversees the Knowledge Areas of Technician Expertise (KATEs) and all test development. KATEs are statistically proven job task analysis from which all questions are developed.</p>
Hour Requirements (includes any instructional, lab/practice hours, or internship hours).	Locally developed curriculum to meet the needs of local industry needs.	
Competencies demonstrated by credential attainment.	<p>The following end-of-course examinations are required to verify the students' knowledge in a 900 clock hour OTC program.</p> <p>NATE: KATE/ICE Competencies</p> <p>RESIDENTIAL (Core):</p> <p>The Core exam tests a candidate's general knowledge, construction knowledge, and HVACR specific knowledge in the areas of:</p> <p>Safety</p> <ul style="list-style-type: none"> • Complying with Government Regulations • Personal Safety and Work Practices 	<p>ICE: Core Exam Competences http://www.natex.org/site/341/Technicians/What-Tests-to-Take/KATEs/Specialty-Tests</p> <p>ICE: Special Section Companies</p> <p>Note: According to NATE Website http://www.natex.org/site/341/Technicians/What-Tests-to-Take/KATEs/Specialty-Tests Individuals who pass the Air-to-Air Heat Pump test are also awarded Air Condition Certification</p>

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- Personal Safety Around Moving Machinery
- Electrical Safety
- Safe Brazing and Soldering Practices
- Safe Handling of Containers
- Understanding Hazmat

Tools

- Tools & Scales - Basic Math Measurement
- Fabrication Tools
- Tubing Tools

Basic Construction

- Plans and Specifications
- Plumbing (Piping) Layout
- Room Specs – Clear Span & Ceiling Heights
- Roofing
- Ceilings
- Walls
- Floors
- Fenestration
- Girders & Trusses
- Chimneys

Using Basic Science

- Chemistry Basics
- Electrons in Electricity
- Electrical Basic Terms
- Magnetism
- AC and DC Circuits
- Basic Circuit Analysis
- Electricity – Generation and Distribution
- Solid State Electronics
- Pressure Measurement
- Mathematics
- Mechanics
- Gas Law

Air Condition (Installation)

<http://www.natex.org/site/341/Technicians/What-Tests-to-Take/KATEs/Specialty-Tests>

Air Distribution (Installation)

<http://www.natex.org/site/341/Technicians/What-Tests-to-Take/KATEs/Specialty-Tests>

Air-to-Air Heat Pumps (Installation)

<http://www.natex.org/site/341/Technicians/What-Tests-to-Take/KATEs/Specialty-Tests>

Gas Furnaces (Installation)

<http://www.natex.org/site/341/Technicians/What-Tests-to-Take/KATEs/Specialty-Tests>

Oil Furnaces (Installation)

<http://www.natex.org/site/341/Technicians/What-Tests-to-Take/KATEs/Specialty-Tests>

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- Electrical Load Types
- Power

Achieving Desired Conditions

- Temperature
- Humidity
- Air Quality
- Sound

Taking Temperature and Humidity Measurements

- Physical measurements – Temperature & Heat
- Thermometers
- Humidity Measurement and Calculations

Basic Electrical

- Symbols
- Field Wiring Diagrams
- Pictorial Diagrams
- Schematic (Ladder) Diagrams
- Single Phase Motors
- Three Phase Motors
- Variable Speed Motors
- Actuator Motors
- Digital Electrical Meters

Specialty Sections: Installation Specialty Exams

Air Conditioning

- Installation
 - Fabricating Copper Tubing
 - Installing Condensing Unit
 - Installing Packaged Units
 - Installing Indoor Equipment
 - Evacuation & Charting
 - Duct Installation
 - Installing Accessories
 - Field Wiring
 - Start-up and Checkout

One-Year Option
900 Clock Hour Certification Affirmation

- Refrigerant Circuit Tools
 - Retrofitting
 - Basic Duct Fabrication
 - Airflow Measurements
 - Service
 - Diagnostics
 - Introduction to Electrical Troubleshooting
 - System Components
 - Introduction to Systems
 - Duct Systems
 - Wiring Layouts
 - Components
 - Electromechanical Sensing Controls
 - Refrigerant Circuit Controls
 - Non-sensing Controls
 - Electronic Controls
 - Applied Knowledge (Regs, Codes & Design)
 - Air Quality Regulations
 - Electrical Code
 - State and Local Regulations and Codes
 - Fire Protection Regulations and Codes
 - Design Considerations – Comfort
 - Design Considerations – Equipment
 - Design Considerations – Components
 - Recovery/recycling Machines
 - Mechanical Code
- Air Distribution – Low Pressure
- Installation
 - Duct Fabrication
 - Duct Installation
 - System Setup
 - Airflow Measurements
 - Service
 - Basic Air Distribution System Inspection
 - Inspection and Repair of Metal Duct Systems

One-Year Option
900 Clock Hour Certification Affirmation

- Inspection and Repair of Duckboard Systems
 - Inspection and Repair of Flexible Duct Systems
 - Inspection and Repair of Grilles and Registers
 - Introduction to Electrical Troubleshooting
 - System Components
 - Introduction to Systems
 - Duct Systems
 - Basic Gas Furnaces
 - Basic Oil Furnaces
 - Basic Air Conditioning/Heat Pumps
 - Basic Airflow Principles
 - Applied Knowledge (Regs, Codes and Design)
 - Air Quality Regulations
 - Electrical Code
 - State and Local Regulations and Codes
 - Fire Protection Regulations and Codes
 - Design Considerations – Comfort
 - Design Considerations – Residential
 - Design Considerations – Components
 - Mechanical Code
 - Industry Standards
 - Design Considerations – Light Commercial
- Air – To – Air Heat Pumps
- Installation
 - Fabricating Copper Tubing
 - Installing Outdoor Units
 - Installing Packaged Units
 - Installing Indoor Units
 - Evacuation & Charging
 - Duct Installation
 - Installing Accessories
 - Field Wiring
 - Start-Up and Checkout
 - Refrigerant Circuit Tools
 - Duct Fabrication

One-Year Option
900 Clock Hour Certification Affirmation

- Retrofitting
 - Airflow Measurements
- Service:
 - Diagnostics
 - Introduction to Electrical Troubleshooting
- System Component:
 - Introduction to Systems
 - Duct Systems
 - Wiring Layouts
 - Components
 - Electromechanical Sensing Controls
 - Refrigerant Circuit Controls
 - Non-Sensing Controls
 - Electronic Controls
- Applied Knowledge (Regs, Codes & Design)
 - Air Quality Regulations
 - Electrical Code
 - State and Local Regulations and Codes
 - Fire Protection Regulations and Codes
 - Design Considerations – Comfort
 - Design Considerations – Equipment
 - Design Considerations – Components
 - Mechanical Code
 - Recovery/Recycling Machines

Gas Furnaces

- Installation
 - Installing Gas Furnaces
 - Duct Installation
 - Installing Accessories
 - Start-up and Checkout
 - Airflow Measurements
- Service
 - Diagnostics
 - Introduction to Electrical Troubleshooting
- System Components

One-Year Option
900 Clock Hour Certification Affirmation

- Introduction to Systems
- Furnace Configurations & Applications
- Combustion Process for Gas Furnaces Systems
- Natural Draft Gas Furnace
- Combustion Air Requirements
- Air Distribution
- Wiring Layouts
- Induced Draft Non-Condensing Furnace
- Induced Draft Condensing Furnace
- Applied Knowledge (Regs, Codes, & Design)
 - Air Quality Regulations
 - Electrical Code
 - State and Local Regulations and Codes
 - Fire Protection Regulations and Codes
 - Design Considerations – Comfort
 - Design Considerations – Equipment
 - Design Considerations – Components
 - Mechanical Code

Oil Furnaces

- Installation
 - Installing Oil Furnaces
 - Duct Installation
 - Installing Accessories
 - Start-up and Checkout
 - Airflow Measurements
- Service
 - Diagnostics and Repair
- System Components
 - Introduction to Systems
 - Furnace Configurations & Applications
 - Combustion Process for Oil Furnaces
 - Natural Draft Oil Furnace – Components
 - Combustion Air Requirements
 - Air Distribution
 - Wiring Layouts

One-Year Option
900 Clock Hour Certification Affirmation

	<ul style="list-style-type: none">• Applied Knowledge: (Regs, Codes, & Design)<ul style="list-style-type: none">○ Air Quality Regulations○ Electrical Code○ State and Local Regulations and Codes○ Fire Protection Regulations and Codes○ Design Considerations – Comfort○ Design Considerations – Equipment○ Design Considerations – Components	
Rationale	<p>The Trades and Industry Credit Affirmation Team (CAT) utilized the following process to complete the assessment regarding the number of semester hours that would be awarded at the college level as block credit based on industry credential(s) plus 900-clock hours earned at an Ohio Technical Center (OTC).</p> <ul style="list-style-type: none">• Research the competencies tested by the industry credential(s). The Trades and Industry CAT reviewed information about the industry credential(s) to determine the competencies signaled by earning the credential(s).• Complete a nationwide internet search to review how other accredited colleges and universities are applying credit to NATE ICE/KATE Exams. The Kansas Board of Regents has articulated the NATE ICE core and one additional test for up to 44 credit hours.• Review the value of local program advisory committee recommendations to meet the local industry needs. The Team concurred that there was value in having lab/practical, internships and/or externships as part of the program to meet local industry/business needs.• Review OSHA 10-Hour Hazard Recognition Training for the General Industry. OSHA 10 includes content essential to general-related work such as fall protection, personal protective equipment, fire prevention and safety, OSHA inspection procedures and more.• Review EPA 608 Universal Licensure Training. EPA 608 Universal Licensure includes content essential to Clean Air Act, Montreal Protocol, Section 608 Regulations regarding refrigeration, recovery, leak detection and repair, recharging and safety. <p>The Trades and Industry CAT confirms:</p> <ul style="list-style-type: none">• The certifications exams are valid, reliable and peer-reviewed on a regular basis to ensure the content accurately measures intended competencies.• The competencies measured by the NATE ICE (KATEs) in the areas of Core Competencies, Electrical, Air Conditioning, Electric Heat, Heat Pump, Gas Heat, Oil Heat, EPA 608 Universal and OSHA 10 General Industry are developed by industry and reflect industry standards. <p>The Trades and Industry CAT also considered competencies signaled by lab and practical learning experiences. As part of</p>	

One-Year Option
900 Clock Hour Certification Affirmation

the program offered by OTCs, student will participate in lab/practical experience as recommended by the local program advisory committee to meet local business and industry needs. The lab/practical experiences will reinforce the instructional competencies through hands-on learning.

Upon successful completion of the 900+ hour program and attainment of the following certifications:

- NATE Core
- NATE Specialty Exam: Air Conditioning
- NATE Specialty Exam: Air Distribution
- NATE Specialty Exam: Air-to-Air Heat Pump
- NATE Specialty Exam: Gas Furnace
- NATE Specialty Exam: Oil Furnace
- EPA 608 Universal
- OSHA 10 General Industry

A student shall be awarded 30 technical semester hours toward completion of an Association of Technical Studies at a public degree granting college or university.

ONLY IF NECESSARY TO AFFIRM 30 CREDITS----STEP TWO: PROGRAM-RELATED COMPETENCIES OBTAINED OUTSIDE OF PRIMARY CREDENTIAL

	Details/Explanation	Comments
Additional related complementary credential(s) or badge(s) (e.g. OSHA 10, CPR).	OSHA 10-Hour: General Industry Certification Universal EPA Section 608 Certification (Various Vendors)	
Competencies demonstrated by additional credential attainment.	OSHA 10- Hour: General Industry: Mandatory - 7 hours of training <ul style="list-style-type: none"> • Introduction to OSHA • Walking and Working Surfaces, including fall protection • Exit Routes, Emergency Action Plans, Fire Prevention Plans, and Fire Protection • Electrical • Personal Protective Equipment • Hazard Communication 	Must be taught by a Certified OSHA Outreach Trainer. https://www.osha.gov/dte/outreach/program_requirements.pdf Elective and Optional components of the OSHA 10-Hour: General Industry Credential will be determined by local program advisory board.

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Elective - 2 hours of Training

Must present at least two hours of training on the following topics. At least two topics must be presented. The minimum length of any topic is one-half hour.

- Hazardous Materials
- Materials Handling
- Machine Guarding
- Introduction to Industrial Hygiene
- Bloodborne Pathogens
- Ergonomics
- Safety and Health Program
- Fall Protection

Optional - 1 hour of Training.

Teach other general industry hazards or policies and/or expand on the mandatory or elective topics. The minimum length of any topic is one-half hour.

Universal EPA Section 608 Certification

CORE

- Ozone Depletion
- Clean Air Act and Montreal Protocol
- Section 608 Regulations
- Substitute Refrigerants and oils
- Refrigeration
- Three R's
- Recovery Techniques
- Dehydration Evacuation
- Safety
- Shipping

TYPE 1 (Small Appliances)

- Recovery Requirements
- Recovery Techniques



Universal Section 608 Certification

<http://www.epa.gov/ozone/title6/608/technicians/certoutl.html#core>

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	<ul style="list-style-type: none"> Safety <p>TYPE 2 (High-Pressure)</p> <ul style="list-style-type: none"> Leak Detection Leak Repair Requirements Recovery Techniques Recovery Requirements Refrigeration Safety <p>TYPE 3 (Low-pressure)</p> <ul style="list-style-type: none"> Leak Detection Leak Repair Requirements Recovery Techniques Recharging Techniques Recovery Requirements Refrigeration Safety 																			
Description of additional program elements beyond primary credential.																				
Program related competencies/learning outcomes outside of credential(s). Include how competencies are demonstrated.	.																			
Related Programs as of Fall 2015	<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Ohio Technical Center</th> <th style="text-align: left;">Program Name</th> <th style="text-align: left;">Clock Hours</th> </tr> </thead> <tbody> <tr> <td>Collins Career Center</td> <td>HVAC</td> <td>900</td> </tr> <tr> <td>Columbus City School District</td> <td>HVAC</td> <td>900</td> </tr> <tr> <td>Great Oaks Institute of Technology</td> <td>HVAC</td> <td>900</td> </tr> <tr> <td>Miami Valley Career Technical Center</td> <td>HVAC</td> <td>900</td> </tr> <tr> <td>Pickaway-Ross Career and Technology Center</td> <td>HVAC</td> <td>900</td> </tr> </tbody> </table>	Ohio Technical Center	Program Name	Clock Hours	Collins Career Center	HVAC	900	Columbus City School District	HVAC	900	Great Oaks Institute of Technology	HVAC	900	Miami Valley Career Technical Center	HVAC	900	Pickaway-Ross Career and Technology Center	HVAC	900	
Ohio Technical Center	Program Name	Clock Hours																		
Collins Career Center	HVAC	900																		
Columbus City School District	HVAC	900																		
Great Oaks Institute of Technology	HVAC	900																		
Miami Valley Career Technical Center	HVAC	900																		
Pickaway-Ross Career and Technology Center	HVAC	900																		

One-Year Option
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	Eastland-Fairfield Career Technical Center	HVAC/R & Controls	1150
Committee Members and Subject Matter Experts:	Name	Role	Institution
	Barbara Wagner	Co-Chair	Upper Valley Career Center
	Kelly Zelesnik	Co-Chair	Lorain County Community College
	Jon Buttelwerth	Member	Cincinnati State Technical and Community College
	Lorraine Kapka	Member	Sinclair Community College
	Mike Sizemore	Member	Miami Valley Career Technical Center
	Tim Conley	Member	Pickaway Ross Career and Technology Center
	Jeffrey Jones	Member	Ashland County West Holmes Career Center
Other Parameters of Competency.			
OTHER COMMENTS. Material covered is adequate to allow 30 hours of credit to be granted.			
AFFIRMED NUMBER OF TECHNICAL BLOCK CREDITS	30 Semester Hours		LENGTH OF TIME CREDENTIAL CAN BE USED FOR ONE-YEAR OPTION: Must have completed a 900+ hour HVAC program at an Ohio Technical Center and meet requirements for one of the pathways as indicated in the preamble. The certifications must be current and valid. Must have completed the Ohio Technical Center program within 5 years.
Co-chair signatures:			
 Dr. Barbara G. A. Wagner, Adult Division Director Upper Valley Career Center – Ohio Technical Center		 Kelly A. Zelesnik, Dean of Engineering Technologies Lorain County Community College	
Date: 5/1/2017			